that interrupts the output from the rectifier in a periodic fashion and it is typically programmable so that the length of the on and off cycles can be adjusted. The influence of other rectifiers is then measured by moving the interrupter to each of these rectifiers in turn and re-visiting each of the test stations. This cycle is repeated for each cathodic protection circuit influencing that length of the pipeline. Thus if there are four cathodic protection circuits affecting a particular length of the pipeline, this cycle will need to be performed four times until the influence of each one of the rectifiers at the cathodic protection circuits has been measured at each of the test stations along the length of the pipeline.

[0020] Current interrupters are also used to determine "instant off" pipe-to-soil potentials at test stations. If a pipe-to-soil potential is measured with rectifiers switched on, there is an inherent error in the measured value because of a voltage drop that occurs due to current flow through the soil. To minimize the effect of rectifier current, the rectifiers are turned off and the pipe-to-soil potential is immediately measured using the voltmeter (typically within 1 second). This value is referred to as the "interrupted off" or "instant off" potential. By measuring at "instant off," any error introduced due to the current of the rectifiers is minimized. This is achieved by installing current interrupters into each influencing rectifier and programming these interrupters to switch off and on at the same time. The interrupters generate "on" and "off" cycles for all of the influencing rectifiers. Some of the available interrupters only have fixed "on" and "off" cycles, while others are programmable and the length of the "off" and of the "on" cycle can be adjusted. Some models also have the ability to program a start and stop time for the interruption cycle. In all the equipment currently available, all of the interrupters switch on and off at the same time. Synchronization of the various interrupters is achieved through synchronizing their internal clocks, often using satellite time signals. U.S. Pat. No. 4,356,444 describes a plurality of interrupters which switch rectifiers on and off in unison. Each interrupter is synchronized with a clock reference unit.

[0021] The testing to determine rectifier influence at each test station requires moving an interrupter from rectifier to rectifier and visiting each of the test stations once for each influencing rectifier. For example, if four rectifiers influence a specific length of pipeline, the interrupter will have to be moved four times and each of the test stations will have to be visited four times. If the "instant off" value also needs to be measured at each test station, it will be necessary to install interrupters into all four rectifiers in order to cycle the rectifiers on and off simultaneously. A fifth visit must then be made to each of the test stations to measure the "instant off" pipe-to-soil potential. Currently no device is available that will allow measurement of the influence from each rectifier and the "instant off" pipe-to-soil potential without having to go through each measurement sequence described above.

[0022] In addition to measuring "instant off" pipe-to-soil potential at each test station (typically spaced 1 mile apart), sometimes it is desirable to measure "instant off" pipe-to-soil potentials at regular intervals between test stations using a methodology known as a close interval survey (CIS). A CIS is performed when the data collected at test stations alone is deemed inadequate and a higher density of data points is required. A CIS is typically performed on a pipeline using a portable pipe-to-soil measurement unit connected to a test station with the reference electrode on the portable pipe-to-soil measurement unit being manually inserted into the ground at spaced intervals between adjacent test stations and a pipe-to-soil measurement taken at each interval. The spacing of data collection points on a CIS varies, but 2.5 to 5 foot intervals are typical. At present, there is also no way of obtaining the rectifier influence in conjunction with a CIS because during a CIS, the interrupters are programmed to simultaneously switch all the rectifiers either all on or all off.

[0023] The present invention overcomes the deficiencies of the prior art.

SUMMARY OF THE INVENTION

[0024] The present invention relates to a cathodic protection remote monitoring unit and method. The remote monitoring unit includes a pipe-to-soil potential measurement unit installed at a test station where the influence of at least one rectifier on the pipe-to-soil potential is known. The pipe-to-soil measurement unit is connected to the pipeline at a first connection point for measuring the potential between a reference electrode and a pipeline at that location. The remote monitoring unit may optionally include a pipeline current measurement unit connected at a second connection point on the pipeline for measuring the current passing through the pipeline between the first and second connection points. The remote monitoring unit monitors the pipe-to-soil potential and by comparing changes in this measured value with the known influence of at least one rectifier, the status of at least one rectifier is monitored. If a pipeline current measurement unit is included, the remote monitoring unit also monitors the amount of current flowing between the first and second connection points. By comparing changes in this measured current value with the known effect that at least one rectifier has, the status of at least one rectifier is monitored.

[0025] In a preferred embodiment of a method of the present invention, a calibration curve is generated showing the influence of each of the cathodic protection circuits at each test station along the pipeline to strategically position each of the remote monitoring units along the pipeline. To determine the influence of each of the plurality of cathodic protection circuits along the pipeline, each one of a plurality of cathodic protection circuits is turned off, while the remainder of the plurality of cathodic protection circuits are left on, with a portable pipe-to-soil potential measurement unit manually measuring the pipe-to-soil potential at each test station along the pipeline. This cycle is repeated until each of the plurality of cathodic protection circuits has been switched off and its influence on the pipe-to-soil potential on the pipeline has been determined. The calibration curve for each cathodic protection circuit is then generated from these measurements. From the calibration curves, a remote monitoring unit is strategically positioned on the pipeline at a location where the pipe-to-soil potential influence of each cathodic protection circuit at such location is distinct and discernable from the measurements taken by the remote monitoring unit at that location.

[0026] The remote monitoring unit is prone to damage by electrical surges. A switch is connected in the AC power and measuring circuits of the remote monitoring unit. The switch maintains the remote monitoring unit in the off position until a measurement is to be made. The switch has a disconnect